

(d) Stability instructions must be in a format easily understood by the master or individual in charge of the vessel. Units of measure, language, and rigor of calculations in the stability instructions must be consistent with the ability of the master or the individual in charge of the vessel. The format of the stability instructions may include, at the owner's discretion, any of the following:

- (1) Simple loading instructions;
- (2) A simple loading diagram with instructions;
- (3) A stability booklet with sample calculations; or
- (4) Any other appropriate format for providing stability instructions.

(e) Stability instructions must be developed based on the vessel's individual characteristics and may include the following, as appropriate for the format chosen for presentation:

- (1) A general description of the vessel, including lightweight data;
- (2) Instructions on the use of the information;
- (3) General arrangement plans showing watertight compartments, closures, vents, downflooding angles, and allowable weights;
- (4) Loading restrictions, such as diagrams, tables, descriptions or maximum KG curves;
- (5) Sample loading conditions;
- (6) General precautions for preventing unintentional flooding;
- (7) Capacity plan or tank sounding tables showing tank and hold capacities, centers of gravity, and free surface effects;
- (8) A rapid and simple means for evaluating any specific loading condition;
- (9) The amount and location of fixed ballast;
- (10) Any other necessary guidance for maintaining adequate stability under normal and emergency conditions;
- (11) A general description of the stability criteria that are used in developing the instructions;
- (12) Guidance on the use of roll limitation devices such as stabilizers; and
- (13) Any other information the owner feels is important to the stability and operation of the vessel.

§ 28.535 Inclining test.

(a) Except as provided in paragraphs (b) and (c) of this section, each vessel for which the lightweight displacement and centers of gravity must be determined in order to do the calculations required in this subpart must have an inclining test performed.

(b) A deadweight survey may be substituted for the inclining test, if there is a record of an inclining test of a sister vessel. A vessel qualifies as a sister vessel if it is built to the same basic drawings and the undocumented weight difference between the two vessels is less than 3 percent of the lightweight displacement of the vessel which was inclined and the location of the longitudinal center of gravity differs less than 1 percent of the vessel's length.

(c) A deadweight survey may be substituted for the inclining test, or the inclining test may be dispensed with, if an accurate estimate of the vessel's lightweight characteristics can be made and the precise location of the position of the vessel's vertical center of gravity is not necessary to ensure that the vessel has adequate stability in all probable loading conditions.

(d) ASTM F 1321 (incorporated by reference, see § 28.40), with the exception of Annexes A and B, may be used as guidance for any inclining test or deadweight survey conducted under this section.

[CGD 88-079, 56 FR 40393, Aug. 14, 1991, as amended by USCG-1999-5151, 64 FR 67176, Dec. 1, 1999]

§ 28.540 Free surface.

(a) When doing the stability calculations required by this subpart, the virtual rise in the vessel's vertical center of gravity due to liquids in tanks must be considered by calculating the following—

(1) For each type of consumable liquid, the maximum free surface effect of a tank, or a transverse pair of tanks, having the greatest free surface effect, in addition to a correction for service tanks; and

(2) The free surface effect of each partially filled tank and hold containing a liquid that is not a consumable or containing fish or a fish product that can shift as the vessel heels. This should

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include correction for any loose water within the vessel's hull associated with the processing of fish.

(b) The free surface effect of tanks fitted with cross connection piping must be calculated assuming the tanks are one common tank, unless valves that will be kept closed to prevent the transfer of liquids as the vessel heels are installed in the piping.

(c) The moment of transference method may be used in lieu of the inertia method when calculating free surface effects.

§ 28.545 Intact stability when using lifting gear.

(a) Each vessel which lifts a weight over the side, or that uses fishing gear that can impose an overturning moment on the vessel, such as trawls and seines, must meet the requirements of this section if that maximum heeling moment exceeds $0.67(W)(GM)(F/B)$, in foot-long tons (meter-metric tons), where:

W=displacement of the vessel with the lifted weight or the force on the fishing gear included, in long tons (metric tons);

GM=metacentric height with the lifted weight or force on the fishing gear included, in feet (meters);

F=freeboard to the lowest weather deck, measured at amidships in feet (meters); and

B=maximum beam, in feet (meters).

(b) Except as provided in paragraph (f) of this section, each vessel must meet the requirements of § 28.570 or have at least 15 foot-degrees (0.080 meter-radians) of area under the righting arm curve, after correcting the righting arms for the heeling arm caused by lifting or fishing gear, from the angle of equilibrium to the least of the following:

(1) The angle corresponding to the maximum righting arm;

(2) The angle of downflooding; or

(3) 40° (0.7 radians).

(c) The angle of intersection of the heeling arm curve resulting from the lifting moment or the moment of fishing gear and the righting arm curve must not be at an angle of more than 10° (0.17 radians).

(d) The heeling arm curve resulting from lifting must be calculated as the

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resultant of the upright heeling moment divided by the vessel's displacement multiplied by the cosine of the angle of heel.

(e) For the purposes of this section, the weight of suspended loads must be assumed to act at the tip of the boom unless the suspended load's transverse movement is restricted, such as by the use of sideboards.

(f) A vessel that operates on protected waters, as defined in § 170.050 of this chapter, must comply with the requirements of this section, except that the area described in paragraph (b) of this section must be at least 10 foot-degrees (0.053 meter-radians).

§ 28.550 Icing.

(a) *Applicability.* Each vessel that operates north of 42° North latitude between November 15 and April 15 or south of 42° South latitude between April 15 and November 15 must meet the requirements of this section.

(b) Except as provided in paragraph (d) of this section, the weight of assumed ice on each surface above the waterline of a vessel which operates north of $66^\circ 30'$ North latitude or south of 66° South latitude must be assumed to be at least:

(1) 6.14 pounds per square foot (30 Kilograms per square meter) of horizontal projected area which corresponds to a thickness of 1.3 inches (33 millimeters); and

(2) 3.07 pounds per square foot (15 Kilograms per square meter) of vertical projected area which corresponds to a thickness of 0.65 inches (16.5 millimeters).

(c) Except as provided in paragraph (d) of this section, the weight of assumed ice on a vessel that operates north of 42° North but south of $66^\circ 30'$ North latitude or south of 42° South but north of 66° South latitude must be assumed to be at least one-half of the values required by paragraphs (b)(1) and (b)(2) of this section.

(d) The height of the center of gravity of the accumulated ice should be calculated according to the position of each corresponding horizontal surface (deck and gangway) and each other continuous surface on which ice can reasonably be expected to accumulate. The projected horizontal and vertical